U S DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE		ATTORNEY'S DOCKET NUMBER
TRANMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371		MAGAIN1
		U S APPLICATION NO (If known,see 37 CFR 1.5) 10/048017
INTERNATIONAL APPLICATION NO. PCT/BE00/00090	INTERNATIONAL FILING DATE 28 July 2000	PRIORITY CLAIMED 28 July 1999

TITLE OF INVENTION
ELECTROLUMINESCENT DEVICE AND METHOD FOR THE PRODUCTION THEREOF

APPLICANT(S) FOR DO/EO/US
MAGAIN, et al.

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. [xx] This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
2. [ ] This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
3. [xx] This is an express request to begin national examination procedures (35 U.S.C. 371(f)) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39(1).
4. [xx] The US has been elected in a Demand by the expiration of 19 months from the priority date (PCT Article 31).
5. [xx] A copy of the International Application as filed (35 U.S.C. 371(c)(2))
   a. [ ] is attached hereto (required only if not transmitted by the International Bureau).
   b. [xx] has been communicated by the International Bureau.
   c. [ ] is not required, as the application was filed in the United States Receiving Office (RO/US).
6. [xx] An English language translation of the International Application as filed (35 U.S.C. 371(c)(2)).
7. [xx] Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3))
   a. [ ] are transmitted herewith (required only if not transmitted by the International Bureau).
   b. [ ] have been communicated by the International Bureau.
   c. [ ] have not been made; however, the time limit for making such amendments has NOT expired.
   d. [xx] have not been made and will not be made.
8. [ ] An English language translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
9. [xx] An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).
10. [ ] An English language translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).

Items 11. to 16. below concern document(s) or information included:

11. [xx] An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
12. [ ] An Assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
13. [xx] A FIRST preliminary amendment.
    [ ] A SECOND or SUBSEQUENT preliminary amendment.
14. [ ] A substitute specification.
15. [ ] A change of power of attorney and/or address letter.
16. [xx] Other items or information:
    [xx] Courtesy copy of the first page of the International Publication (WO 01/10173).
    [xx] Courtesy copy of the International Preliminary Examination Report in French. There were no annexes.
    [xx] Formal drawings, 2 sheets, Figures 1-4.
    [ ] Courtesy Copy of the International Search Report.
    [ ] Applicant claims small entity status. See 37 CFR 1.27.
    [xx] The application is (or will be) assigned to: RECHERCHE ET DEVELOPPEMENT DU GROUPE COCKERILL SAMBRE , whose address is Campus Universitaire du Sart-Tilman, Boulevard de Colonster B 57, B-4000 Liege, Belgium.

28 JAN 2002

U.S. APPLICATION NO (If known, see 37 CFR 1 5)	International Application No	Attorney's Docket No.
10/048017	PCT/BE00/00090	MAGAIN1

17. [xx] The following fees are submitted:	CALCULATIONS PTO USE ONLY	
BASIC NATIONAL FEE (37 CFR 1.492 (a)(1) –(5):		
Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO and International Search Report not prepared by the EPO or JPO.....**$1040.00**		
International preliminary examination fee (37 CFR 1.482) not paid to USPTO but International Search Report prepared by the EPO or JPO.....**$890.00**		
International preliminary examination fee (37 CFR 1.482) not paid to USPTO but international search fee (37 CFR 1.445(a)(2)) paid to USPTO.....**$740.00**		
International preliminary examination fee paid to USPTO (37 CFR 1.482) but all claims did not satisfy provisions of PCT Article 33(1)-(4).....**$710.00**		
International preliminary examination fee paid to USPTO (37 CFR 1.482) and all claims satisfied provisions of PCT Article 33(1)-(4).....**$100.00**		
ENTER APPROPRIATE BASIC FEE AMOUNT =	$ 890.00	
Surcharge of **$130.00** for furnishing the oath or declaration later than [ ] 20 [ ] 30 months from the earliest claimed priority date (37 CFR 1.492(e)).	$	

Claims as Originally Presented	Number Filed	Number Extra	Rate		
Total Claims	25 - 20	5	X $18.00	$ 90.00	
Independent Claims	2 - 3	0	X $84.00	$	
Multiple Dependent Claims (if applicable)			+$280.00	$ 280.00	
TOTAL OF ABOVE CALCULATIONS =				$ 1,260.00	
Claims After Post Filing Prel. Amend	Number Filed	Number Extra	Rate		
Total Claims	26 - 25	1	X $18.00	$ 18.00	
Independent Claims	2 - 3	0	X $84.00	$	
TOTAL OF ABOVE CALCULATIONS =				$	

Reduction of ½ for filing by small entity, if applicable. Applicant claims small entity status. See 37 CFR 1.27.	$ 1,278.00	
SUBTOTAL =	$ 1,278.00	
Processing fee of **$130.00** for furnishing the English translation later than [ ] 20 [ ] 30 months from the earliest claimed priority date (37 CFR 1.492(f)).	$	
TOTAL NATIONAL FEE =	$ 1,278.00	
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). **$40.00** per property +	$	
TOTAL FEES ENCLOSED =	$ 1,278.00	
	Amount to be: refunded	$
	charged	$

a. [ ] A check in the amount of $_____ to cover the above fees is enclosed.
b. [XX] Credit Card Payment Form (PTO-2038), authorizing payment in the amount of $ 1,278.00, is attached.
c. [ ] Please charge my Deposit Account No. **02-4035** in the amount of $_____ to cover the above fees. A duplicate copy of this sheet is enclosed.
d. [**XX**] The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. **02-4035**. A duplicate copy of this sheet is enclosed.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

SEND ALL CORRESPONDENCE TO:

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Date of this submission: **January 28, 2002**

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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of: MAGAIN et al.	)	Art Unit:
IA No.: PCT/BE00/00090	)	Washington, D.C.
IA Filed: 28 July 2000	)	
U.S. App. No.: (Not Yet Assigned)	)	January 28, 2002
National Filing Date: (Not Yet Received)	)	
For: ELECTROLUMINESCENT...	)	Docket No.: MAGAIN1

PRELIMINARY AMENDMENT

Honorable Commissioner for Patents and Trademarks
Washington, D.C. 20231

Sir:

Prior to examination on the merits, kindly amend as follows:

IN THE CLAIMS

Please amend claims 3-17 and 19-24 as follows:

3. (Amended) Device according to one of Claims 1 and 2, wherein the metallic alloy is a steel.

4. (Amended) Device according to claim 1, wherein the substrate (2) is connected to the current source (1, 8).

5. (Amended) Device according to Claim 4, wherein the substrate (2) forms one of the said two electrodes.

6. (Amended) Device according to Claim 4, wherein the substrate (2) is in electrically conductive contact with one of the said two electrodes (3) and forms a current feed for it.

7. (Amended) Device according to claim 1, wherein the substrate (2) supports one of the said two electrodes (3), which is connected to the current source (1, 8).

8. (Amended) Device according to claim 1, wherein the substrate (2) is formed by a steel sheet which has undergone a surface treatment.

9. (Amended) Device according to Claim 8, wherein the substrate (2) which has undergone a surface treatment has superficially in the steel sheet a compound which is a conductor of electricity (10).

10. (Amended) Device according to Claim 8, wherein the steel sheet has a surface coating which is a conductor of electricity (3, 9, 12).

11. (Amended) Device according to Claim 10, wherein the surface coating comprises at least one layer of a material chosen from amongst the group consisting of zinc, zinc alloyed with aluminium, aluminium, magnesium, calcium, tin and chromium.

12. (Amended) Device according to Claim 10, wherein the surface coating consists of at least one layer of at least one conductive polymer.

13. (Amended) Device according to Claim 12, wherein the said at least one conductive polymer is chosen from amongst the group consisting of polyacetylene, polyaniline, polypyrrole, polythiophene, derivatives thereof and mixtures thereof.

14. (Amended) Device according to claim 8, wherein the substrate (2) is made from steel treated so as to reflect a light emitted from the said at least one layer of organic electroluminescent semiconductor (4, 4', 4").

15. (Amended) Device according to claim 2, wherein the second electrode (5) has, opposite the substrate (2), an encapsulation (6) made from a transparent material impervious to air and water.

16. (Amended) Device according to claim 1, wherein the substrate (2) has two parts, an electrically conductive part which supports the said device and which is possibly connected to the current source and a part remaining electrically insulated vis-à-vis the outside.

17. (Amended) Device according to claim 1, wherein the substrate has a first surface on which it supports the said device and a second surface, opposite to the first, on which it supports an additional electroluminescent device according to Claim 1.

19. (Amended) Method according to Claim 18, wherein the substrate consists of a steel sheet.

20. (Amended) Method according to one of Claims 18 and 19, wherein said arrangement of a first electrode

comprises an activation of the steel sheet to make it able to fulfil a role of first electrode, the method comprises an electrical connection between the electrical current source and the steel sheet.

21. (Amended) Method according to one of Claims 18 and 19, wherein said arrangement of a first electrode comprises an application of the first electrode to a surface of the substrate.

22. (Amended) Method according to claim 18, comprising first of all a surface treatment of the substrate.

23. (Amended) Method according to Claim 22, comprising, by way of surface treatment, a surface coating of the substrate by at least one electrically conductive compound.

24. (Amended) Method according to Claim 22, comprising, by way of surface treatment, an enrichment of the substrate, at least on the surface, with an electrically conductive compound.

Please add new claim 25 as follows:

--25. (New) Method according to claim 18, further comprising a deposition of a transparent material impervious to air and water on the second electrode, so as to encapsulate the device.--

REMARKS

The above amendments to the claims are being made in order to place ~~the~~ them into better condition for examination.

Attached hereto is a marked-up version of the

changes made to the specification and claims by the current amendment. The attached page is captioned "**Version with Markings to Show Changes Made**."

Favorable consideration and allowance are earnestly solicited.

Respectfully submitted,
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VERSION WITH MARKINGS TO SHOW CHANGES MADE

3. (Amended) Device according to one of Claims 1 and 2, ~~characterised in that~~ wherein the metallic alloy is a steel.

4. (Amended) Device according to ~~any one of Claims 1 to 3, characterised in that~~ claim 1, wherein the substrate (2) is connected to the current source (1, 8).

5. (Amended) Device according to Claim 4, ~~characterised in that~~ wherein the substrate (2) forms one of the said two electrodes.

6. (Amended) Device according to Claim 4, ~~characterised in that~~ wherein the substrate (2) is in electrically conductive contact with one of the said two electrodes (3) and forms a current feed for it.

7. (Amended) Device according to ~~any one of Claims 1 to 3, characterised in that~~ claim 1, wherein the substrate (2) supports one of the said two electrodes (3), which is connected to the current source (1, 8).

8. (Amended) Device according to ~~any one of Claims 1 to 6, characterised in that~~ claim 1, wherein the substrate (2) is formed by a steel sheet which has undergone a surface treatment.

9. (Amended) Device according to Claim 8, ~~characterised in that~~ wherein the substrate (2) which has undergone a surface treatment has superficially in the steel sheet a compound which is a conductor of electricity (10).

10. (Amended) Device according to Claim 8, ~~characterised in that~~ wherein the steel sheet has a surface coating which is a conductor of electricity (3, 9, 12).

11. (Amended) Device according to Claim 10, ~~characterised in that~~ wherein the surface coating comprises at least one layer of a material chosen from amongst the group consisting of zinc, zinc alloyed with aluminium, aluminium, magnesium, calcium, tin and chromium.

12. (Amended) Device according to Claim 10, ~~characterised in that~~ wherein the surface coating consists of at least one layer of at least one conductive polymer.

13. (Amended) Device according to Claim 12, ~~characterised in that~~ wherein the said at least one conductive polymer is chosen from amongst the group consisting of polyacetylene, polyaniline, polypyrrole, polythiophene, derivatives thereof and mixtures thereof.

14. (Amended) Device according to ~~any one of Claims 8 to 13, characterised in that~~ claim 8, wherein the substrate (2) is made from steel treated so as to reflect a light emitted from the said at least one layer of organic electroluminescent semiconductor (4, 4', 4").

15. (Amended) Device according to ~~any one of Claims 2 to 14, characterised in that~~ claim 2, wherein the second electrode (5) has, opposite the substrate (2), an encapsulation (6) made from a transparent material impervious to air and water.

16. (Amended) Device according to ~~any one of Claims 1 to 15, characterised in that~~ claim 1, wherein the substrate (2) has two parts, an electrically conductive part which supports the said device and which is possibly connected to the current source and a part remaining electrically insulated vis-à-vis the outside.

17. (Amended) Device according to ~~any one of Claims 1 to 15, characterised in that~~ claim 1, wherein the substrate has a first surface on which it supports the said device and a second surface, opposite to the first, on which it supports an additional electroluminescent device according to Claim 1.

19. (Amended) Method according to Claim 18, ~~characterised in that~~ wherein the substrate consists of a steel sheet.

20. (Amended) Method according to one of Claims 18 and 19, ~~characterised in that the~~ wherein said arrangement of a first electrode comprises an activation of the steel sheet to make it able to fulfil a role of first electrode ~~and in that~~, the method comprises an electrical connection between the electrical current source and the steel sheet.

21. (Amended) Method according to one of Claims 18 and 19, ~~characterised in that~~ wherein ~~the~~ said arrangement of a first electrode comprises an application of the first electrode to a surface of the substrate.

22. (Amended) Method according to ~~one of Claims 18 to 21, characterised in that it comprises~~ claim 18, comprising first of all a surface treatment of the substrate.

23. (Amended) Method according to Claim 22, ~~characterised in that it comprises~~comprising, by way of surface treatment, a surface coating of the substrate by at least one electrically conductive compound.

24. (Amended) Method according to Claim 22, ~~characterised in that it comprises~~comprising, by ,way of surface treatment, an enrichment of the substrate, at least on the surface, with an electrically conductive compound.

25. (New) Method according to claim 18, further comprising a deposition of a transparent material impervious to air and water on the second electrode, so as to encapsulate the device.

(12) DEMANDE INTERNATIONALE PUBLIÉE EN VERTU DU TRAITÉ DE COOPÉRATION EN MATIÈRE DE BREVETS (PCT)

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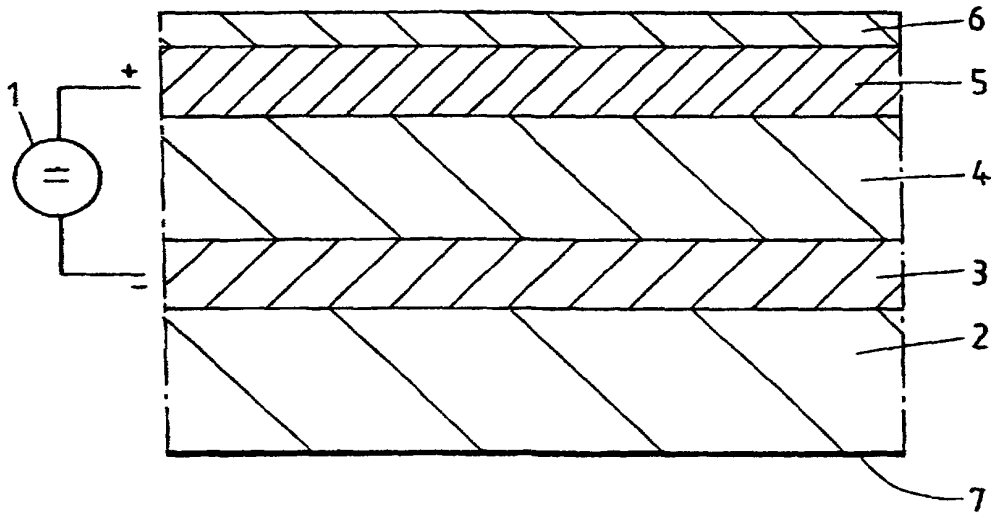
[Suite sur la page suivante]

(54) Title: ELECTROLUMINESCENT DEVICE AND METHOD FOR THE PRODUCTION THEREOF

(54) Titre: DISPOSITIF ELECTROLUMINESCENT ET SON PROCEDE DE FABRICATION



(57) Abstract: An electroluminescent device comprising two electrodes (3, 5) whereby at least one organic electroluminescent semiconducting layer (4) is arranged therebetween, in addition to a substrate (2) supporting said device, and an electric current source (1) which is electroconductively linked to said electrodes. The inventive device is characterized in that the substrate (2) is made of a metal or metal alloy.

[Suite sur la page suivante]

WO 01/10173 A1

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"ELECTROLUMINESCENT DEVICE AND ITS METHOD OF MANUFACTURE"

The present invention relates to an electroluminescent device comprising two electrodes, between which there is arranged at least one electroluminescent organic semiconductor layer, and a substrate supporting the said device, as well as an electric current source connected to the electrodes in an electrically conductive manner. The invention also concerns a method of manufacturing such a device.

Within the meaning of the invention, the expression "at least one electroluminescent organic semiconductor layer" means an electrically conductive, possibly multilayer, organic material in which an electroluminescence phenomenon may arise when on the one hand electrons and on the other hand positive holes are injected therein. The recombination of these charges with opposite signs causes the emission of light. This is therefore, in the sense of the invention, an electroluminescence said to be by injection.

The phenomenon of electroluminescence using organic semiconductors was revealed for the first time in the 1960s and the development of these electroluminescent systems based on organic thin films dates from the second half of the 1980s. In this regard reference can be made to the following publications: A.L. Kraft, A.C. Grimsdale, A.B. Holmes, Electroluminescent conjugated polymers – Seeing polymers in a new light, Angew. Chem. Int. Ed. (1998) 37, 402-428, and R.H. Friend, R.W. Gymer, A.B. Holmes, J.H. Burroughes, R.N. Marks, C. Taliani, D.D.C. Bradley, D.A. Dos Santos, J.L. Bredas, M. Lögdlund,

W.R. Salaneck, Electroluminescence in conjugated polymers, Nature/1999/397, 121-128.

In the majority of the cases of the systems used, it is the glass which is taken as a substrate. Successive thin layers constituting the electroluminescent system are deposited on this. More recently, PET (polyethylene terephthalate) has been envisaged for replacing glass. Glass and PET being transparent, indium-tin oxide (ITO) is deposited directly on this substrate, constituting the positive electrode intended, in DC current, to inject positive holes into the organic semiconductor, which is in its turn deposited in one or more layers, possibly consisting of different molecules, on the layer of ITO. Finally, a thin layer of aluminium, magnesium or calcium is deposited on the whole, constituting in DC current the negative electrode intended to inject electrons into the organic semiconductor. It is the hole-electron recombination which generates the light emitted by the system through the glass or PET substrate. In the systems which use alternating current (SCALE: Symmetrically Configured Alternating current Light Emitting devices), the same electrodes are found (ITO on glass or on PET and aluminium, copper or gold) but electrodes no longer necessarily need to have a working function different from each other.

These devices have the drawback that the substrate is a thermally insulating material. During use at high power density this substrate does not allow an appropriate release of heat, which can result in disturbance in the device. In addition, in the case of glass, the substrate is fragile whilst in the case of PET it is flexible. Neither of these two substrates therefore resists the static and dynamic mechanical stresses borne during the use of electroluminescent devices.

Systems are also known which make use of "phosphoruses" as a source of electroluminescence. These phosphoruses are inorganic compounds which are separated from a

conductive rigid substrate by a dielectric layer, possibly with variable resistance. The phosphoruses are generally encapsulated, for example in a polymerisable resin. They are placed in an alternating electric field which moves the electrons created within them by thermal agitation and the corresponding positive holes created in the valency band. These electrons produce excitations by collision, with the subsequent production of light. This is therefore in this case what is called intrinsic electroluminescence (see for example WO-97/46053 and US-A-3.626.240).

To excite the "phosphoruses" it is necessary to create an alternating field of sufficient intensity, and hence the necessity for the presence of a dielectric and/or resistive layer. The result is high electrical voltages of 60 to 500 V in oscillating alternating current at 50 Hz – 2.5 kHz and high thicknesses of approximately 100 µm.

The purpose of the present invention is to develop an electroluminescent device with an organic semiconductor which makes it possible to avoid these problems in a simple fashion.

An electroluminescent device as described at the start has been provided according to the invention, in which the substrate consists of a metal or metallic alloy. Such a substrate has sufficient thermal conductivity to allow discharge of the heat released by the electroluminescent system, especially when the latter is used at high power density.

Advantageously the metallic alloy is a steel, for example soft steel or stainless steel. Steel offers the property of being both rigid and easy to shape, which is advantageous for many applications of electroluminescent devices, such as illuminating panels and external or internal luminaires, decorative systems and fixed or programmable display systems.

According to one advantageous embodiment of the invention, a first electrode is disposed on a first side of the said at least one layer of electroluminescent organic semiconductor, on a first surface thereof which faces the substrate, and a second electrode is disposed on a second side of the said at least one layer of electroluminescent organic semiconductor, on a second surface thereof which is opposite the substrate, this second electrode allowing an at least partial passage of light.

As already mentioned, the device can comprise one or more successive layers of electroluminescent organic semiconductor. First surface and second surface mean, in the case of a single layer of semiconductor, the two faces thereof. In the case of several successive layers, they are the two external faces of this set of layers.

Using a substrate made of metal, metallic alloy or steel advantageously has the effect of allowing a reversal in the arrangement of the layers in the electroluminescent system compared with that of the systems according to the state of the art. This is because the light emitted by the device no longer passes through the substrate but only through one of the electrodes, the one opposite to the substrate, and through any external encapsulation thereof in transparent material, preferably impervious to water and air.

Advantageously, to manufacture this electrode situated opposite the substrate the most transparent possible material is used. It is possible to envisage for example inorganic electrode materials as used in the known electroluminescent or photovoltaic devices for electrodes supported directly by a glass or PET substrate. It is possible to cite, as non-exhaustive examples, indium-tin oxide (ITO), indium-zinc oxide (IZO) or systems based on indium-(zinc, gallium) oxides or ZnO, SnO2, ZnS, CdS, ZnSe, ZnxCd1-xO, ZnTe. It is also possible to use organic transparent electrically conductive materials, such as for

example p-doped conjugated polymers, polypyrrole, polythiophene, polyaniline, polyacetylene (CHx) as well as derivatives of mixtures of these substances. It is also possible to make use of several of these superimposed conductive layers, for example a layer of ITO coated with a conjugated polymer.

As a transparent encapsulation material, it is possible to provide by way of example a thin layer of silica deposited for example by the so-called PECVD (Physical Enhanced Chemical Vapour Deposition) technique (SiOx).

According to one advantageous embodiment of the invention, the substrate is connected to the current source. The steel is a good electronic conductor and it can therefore serve as a current feed for one of the electrodes with which it is contact. The substrate can itself serve as an electrode.

It is obviously possible also to provide a device according to the invention in which the substrate supports an electrode which is directly connected to the current source without the current passing through the substrate.

As an electrode material situated on the substrate side, it is possible to envisage any appropriate material for this purpose. Notably the materials indicated above for the electrode situated opposite the substrate can be envisaged. It is however also possible to envisage, as an electrode, the substrate in the form not only of steel sheet itself but more particularly in the form of this sheet which has undergone a surface treatment.

For surface treatment, it is possible to envisage according to the invention any treatment for obtaining superficially in the sheet or on the surface of the sheet a compound which is a good conductor of electricity. It is for example possible to first treat the steel sheet by means of a controlled oxidation so that, at least on the surface, it has a

greater proportion of a good conductor, for example Fe3O4. This controlled oxidation can be designed in a known manner, for example by electrolysis or oxidation in air.

It is also possible to provide, as a surface treatment, the application to the steel sheet of a conductive coating, notably zinc, zinc slightly or greatly alloyed with aluminium, aluminium, chromium or tin. Such coatings can for example be obtained, according to circumstances, by electrolytic deposition or by hot quenching deposition, according to techniques known to experts.

It is also possible to envisage, as surface treatment, the application to the substrate of a thin layer of a metal or alloy other than the one forming the substrate, for example aluminium, magnesium or calcium on a steel sheet. This application can be effected by any means known to experts, for example by vacuum evaporation or cathodic sputtering.

It is possible to envisage the application to the bare substrate, or to the substrate already with surface treatment, of at least one conductive polymer. It is possible to cite, as examples of conductive polymer, polyacetylene, polyaniline, polypyrrole, polythiophene, derivatives thereof and mixtures thereof.

According to one advantageous embodiment of the invention, the substrate is made from steel treated so as to reflect a light emitted from the organic electroluminescent semiconductor layer. The non-transparent steel serving as a substrate can for this purpose be for example polished, as well as its non-transparent coating. It is also possible for the electrode provided on the substrate side and any surface coating of the substrate also to be transparent. Such an arrangement makes it possible to increase not insignificantly the light emission efficiency of the system.

As an electrode material, it is possible to use in particular in this case a material as indicated above with regard to the materials to be used for the electrode situated opposite the substrate.

The replacement of the glass or PET, transparent products, as a substrate by steel, a non-transparent product, makes it possible to use both faces to create electroluminescent devices which are identical or possibly different from one face to the other (changing colour or display).

Other details and particularities of the device according to the invention are indicated in Claims 1 to 17. The present invention also concerns a method of manufacturing an electroluminescent device, comprising an arrangement of at least one layer of electroluminescent organic semiconductor between two electrodes, a support for the device by means of a substrate, and a connection of the electrodes to an electric current source. According to the invention, this method comprises an arrangement of a first electrode on a substrate consisting of a metal or metallic alloy, a deposition of said at least one layer of electroluminescent organic semiconductor on the first electrode, and a deposition of a second electrode allowing an at least partial passage of the light on the said at least one layer of organic semiconductor and, possibly a deposition of a transparent material impervious to air and water on the second electrode, so as to encapsulate the device.

Other details and particularities of the method according to the invention are indicated in Claims 18 to 24.

Other details and particularities of the invention will emerge from the description given below, non-limitatively and with reference to the accompanying drawings, of a few example embodiments of the device according to the invention.

Figures 1 to 4 are schematic representations in section of devices according to the invention. It should be noted that the given

dimensions are not to scale. The relative dimensions between layers are also not complied with.

Figure 1 depicts an electroluminescent device supplied by a DC current source 1. The substrate 2 is formed by a steel sheet, for example made from soft steel, which supports a thin layer 3 of a zinc and aluminium alloy, serving as a negative electrode. This layer can for example be deposited on the steel by a hot-bath immersion method. A layer of appropriate electroluminescent organic semiconductor 4 is applied to the negative electrode 3 for example in the form of a solution from which the solvent is then evaporated at atmospheric pressure or under partial vacuum, or by evaporation-condensation under vacuum of oligomers with a fairly low molecular mass. On the side opposite to the substrate 2, a positive electrode 5, which is transparent, based for example on ITO, is deposited advantageously under vacuum on the layer of organic semiconductor 4, for example according to the technique of reactive cathodic sputtering. Finally, there is provided, in order to protect the whole, a transparent encapsulation layer 6, for example made from silica, applied notably by a method of the PECVD (Physical Enhanced Chemical Vapour Deposition) type, and on the external face of the steel sheet 2 an insulation, for example in the form of a layer of electrically insulating paint 7.

The at least one layer of electroluminescent organic semiconductor according to the invention is a thin layer which can have a maximum thickness of a few micrometres.

In the case illustrated in this Figure 1, the current source 1 is directly connected to each of the electrodes 3 and 5. It is of course possible to provide a connection of the current source 1 to the steel sheet 2, which would then serve as a current feed to the electrode 3.

In Figure 2, a device has been provided similar to the one illustrated in Figure 1, but to be used with a power supply from an AC

current source 8. This is connected on the one hand to the electrode layer based on ITO 5 and on the other hand to the steel sheet 2 forming the substrate and serving simultaneously as an electrode opposite the electrode 5. The two electrodes serve alternately as a positive electrode and negative electrode.

To improve the distribution and the passage of electricity, the sheet is coated on the surface with a layer of organic conductor 9, for example CHx (polyacetylene), which can be deposited on the sheet by vacuum reactive cathodic sputtering. This layer is advantageously transparent and the surface of the sheet coated with this layer 9 has been treated previously in order to reflect the light emitted by the electroluminescent system, which improves the efficiency thereof.

In the example embodiment illustrated in Figure 2, two layers 4', 4" of electroluminescent organic semiconductors have been shown, these being able to be identical in the successive layers, or different.

It is also possible to provide between the layers 4', 4" and the ITO-based electrode a layer of polyacetylene, not shown, similar to the layer 9, in order to improve here also the distribution and passage of electricity.

The example embodiment illustrated in Figure 3 is identical to the one in Figure 1, except that the substrate 2 serves here as a positive electrode. For this purpose, it has advantageously been oxidised in a controlled manner in order to show a layer 10 with a higher content for example of Fe3O4. The opposite electrode 11 in this case advantageously consists of a transparent conductive polymer.

In the example embodiment according to Figure 4, the soft steel sheet serves as a substrate 2 for two electroluminescent devices identical on each of its faces.

The faces of the substrate have been activated on the surface by vacuum plasma, and then a layer of aluminium 12 has been deposited on each of them, for example by evaporation or vacuum cathodic sputtering.

Between the successive layers 4', 4" of electroluminescent organic semiconductor and the electrode formed by the layer of ITO 5, a layer of polyacetylene 13 has been provided to improve the distribution and the passage of the electric current.

An arrangement as provided in this figure is impossible to envisage with the electroluminescent devices according to the known state of the art since, in the latter, the light must be able to pass through the substrate.

It must be understood that the present invention is in no way limited to the embodiments described above and that many modifications can be made to them without departing from the scope of the claims.

It would for example be possible to introduce, between the substrate and the at least one layer of electroluminescent organic semiconductor, a very thin layer of an electrical insulator nevertheless allowing the passage of electrons by tunnel effect, with a view for example to homogenising the transfer of electrons.

It would also be possible to envisage introducing, into the at least one layer of electroluminescent organic semiconductor, electrophosphorescent molecules for improving the quantum yield.

CLAIMS

1. Electroluminescent device comprising two electrodes (2, 3, 5) between which there is arranged at least one layer of electroluminescent organic semiconductor (4, 4', 4"), and a substrate (2) supporting the said device, as well as an electric current source (1, 8) connected to the electrodes in an electrically conductive manner, characterised in that the substrate (2) consists of a metal or metallic alloy.

2. Device according to Claim 1, characterised in that a first electrode (2, 3) is disposed on a first side of the said at least one layer of electroluminescent organic semiconductor (4, 4', 4"), on a first face thereof which faces the substrate (2), and in that a second electrode (5) is disposed on a second side of said at least one layer of electroluminescent organic semiconductor (4, 4', 4"), on a second face thereof which is opposite the substrate (2), this second electrode (5) allowing an at least partial passage of the light.

3. Device according to one of Claims 1 and 2, characterised in that the metallic alloy is a steel.

4. Device according to any one of Claims 1 to 3, characterised in that the substrate (2) is connected to the current source (1, 8).

5. Device according to Claim 4, characterised in that the substrate (2) forms one of the said two electrodes.

6. Device according to Claim 4, characterised in that the substrate (2) is in electrically conductive contact with one of the said two electrodes (3) and forms a current feed for it.

7. Device according to any one of Claims 1 to 3, characterised in that the substrate (2) supports one of the said two electrodes (3), which is connected to the current source (1, 8).

8. Device according to any one of Claims 1 to 6, characterised in that the substrate (2) is formed by a steel sheet which has undergone a surface treatment.

9. Device according to Claim 8, characterised in that the substrate (2) which has undergone a surface treatment has superficially in the steel sheet a compound which is a conductor of electricity (10).

10. Device according to Claim 8, characterised in that the steel sheet has a surface coating which is a conductor of electricity (3, 9, 12).

11. Device according to Claim 10, characterised in that the surface coating comprises at least one layer of a material chosen from amongst the group consisting of zinc, zinc alloyed with aluminium, aluminium, magnesium, calcium, tin and chromium.

12. Device according to Claim 10, characterised in that the surface coating consists of at least one layer of at least one conductive polymer.

13. Device according to Claim 12, characterised in that the said at least one conductive polymer is chosen from amongst the group consisting of polyacetylene, polyaniline, polypyrrole, polythiophene, derivatives thereof and mixtures thereof.

14. Device according to any one of Claims 8 to 13, characterised in that the substrate (2) is made from steel treated so as to reflect a light

emitted from the said at least one layer of organic electroluminescent semiconductor (4, 4', 4").

15. Device according to any one of Claims 2 to 14, characterised in that the second electrode (5) has, opposite the substrate (2), an encapsulation (6) made from a transparent material impervious to air and water.

16. Device according to any one of Claims 1 to 15, characterised in that the substrate (2) has two parts, an electrically conductive part which supports the said device and which is possibly connected to the current source and a part remaining electrically insulated vis-à-vis the outside.

17. Device according to any one of Claims 1 to 15, characterised in that the substrate has a first surface on which it supports the said device and a second surface, opposite to the first, on which it supports an additional electroluminescent device according to Claim 1.

18. Method of manufacturing an electroluminescent device, comprising

- an arrangement of at least one layer of electroluminescent organic semiconductor between two electrodes,

- a support for the device by means of a substrate, and

- a connection of the electrodes to an electric current source,

characterised in that it comprises

- an arrangement of a first electrode on a substrate consisting of a metal or metallic alloy,

- a deposition of said at least one layer of electroluminescent organic semiconductor on the first electrode, and

- a deposition of a second electrode allowing an at least partial passage of the light on the said at least one layer of organic semiconductor,

- and, possibly, a deposition of a transparent material impervious to air and water on the second electrode, so as to encapsulate the device.

19. Method according to Claim 18, characterised in that the substrate consists of a steel sheet.

20. Method according to one of Claims 18 and 19, characterised in that the said arrangement of a first electrode comprises an activation of the steel sheet to make it able to fulfil a role of first electrode and in that the method comprises an electrical connection between the electrical current source and the steel sheet.

21. Method according to one of Claims 18 and 19, characterised in that the said arrangement of a first electrode comprises an application of the first electrode to a surface of the substrate.

22. Method according to one of Claims 18 to 21, characterised in that it comprises first of all a surface treatment of the substrate.

23. Method according to Claim 22, characterised in that it comprises, by way of surface treatment, a surface coating of the substrate by at least one electrically conductive compound.

24. Method according to Claim 22, characterised in that it comprises, by way of surface treatment, an enrichment of the substrate, at least on the surface, with an electrically conductive compound.

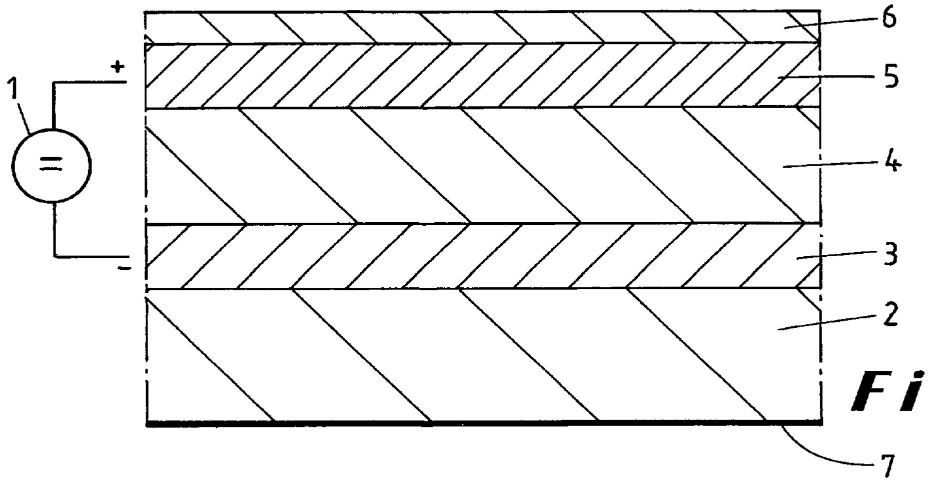

Fig. 1

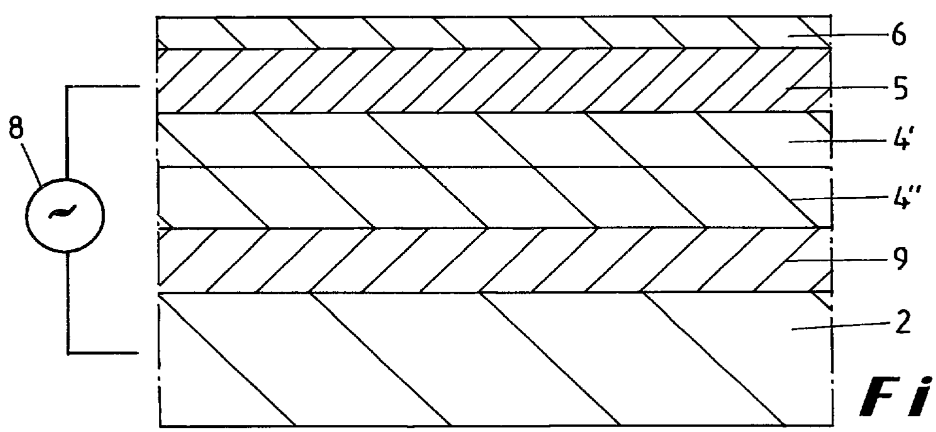

Fig. 2

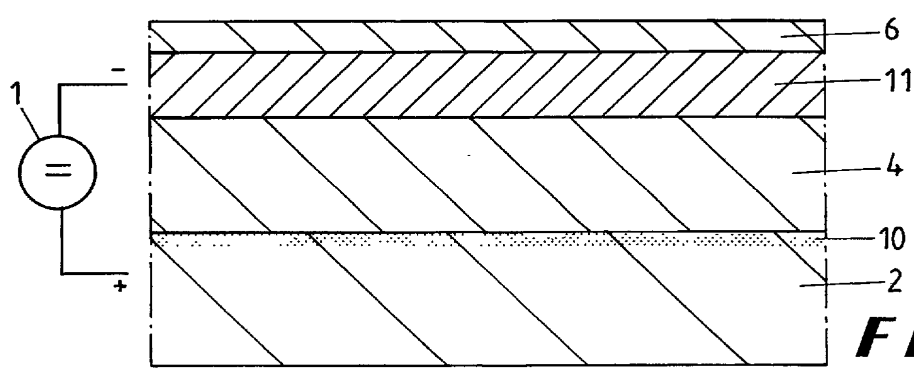

Fig. 3

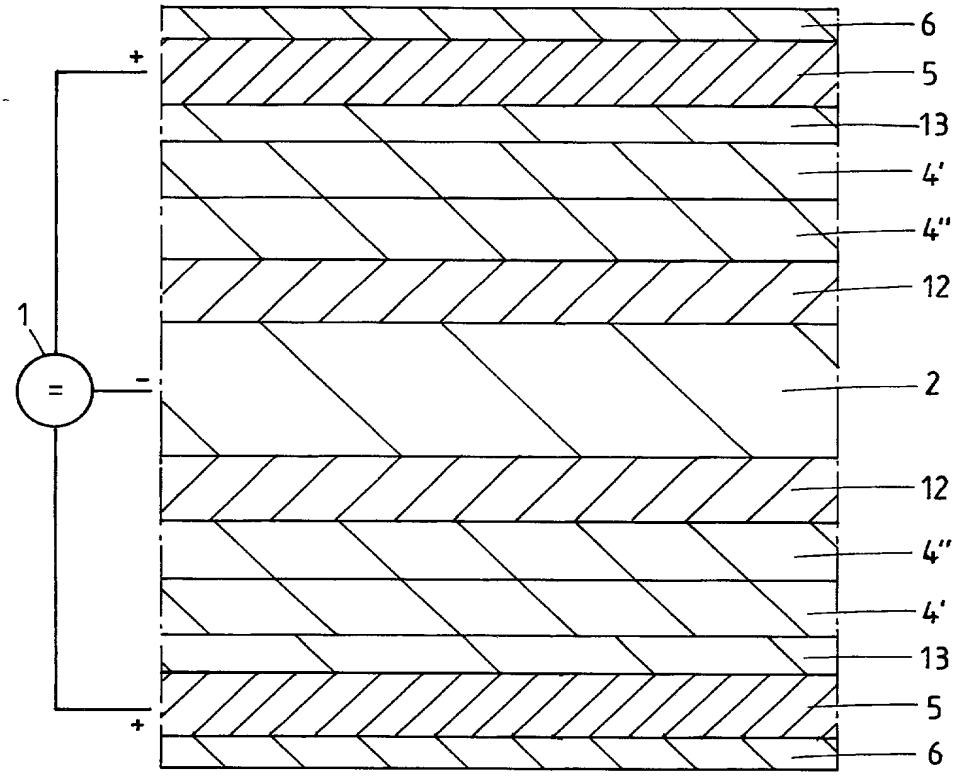

Fig. 4

Page 2 of 2 Pages Atty. Docket:
Title: Electroluminescent devicef and its method of manufacture
U.S. Application filed _____, Serial No. _____
PCT Application filed July 28, 2000, Serial No. PCT/BE00/00090

The undersigned hereby authorizes the U.S. Attorneys or Agents appointed herein to accept and follow instructions from _____ as to any action to be taken in the U.S. Patent and Trademark Office regarding this application without direct communication between the U.S. Attorneys or Agents and the undersigned. In the event of a change of the persons from whom instructions may be taken, the U.S. Attorneys or Agents appointed herein will be so notified by the undersigned.

I hereby further declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under 18 U.S.C. §1001 and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

FULL NAME OF FIRST INVENTOR	INVENTOR'S SIGNATURE	DATE
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FULL NAME OF THIRD JOINT INVENTOR	INVENTOR'S SIGNATURE	DATE
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POST OFFICE ADDRESS		
FULL NAME OF FOURTH JOINT INVENTOR	INVENTOR'S SIGNATURE	DATE
RESIDENCE		CITIZENSHIP
POST OFFICE ADDRESS		
FULL NAME OF FIFTH JOINT INVENTOR	INVENTOR'S SIGNATURE	DATE
RESIDENCE		CITIZENSHIP
POST OFFICE ADDRESS		
FULL NAME OF SIXTH JOINT INVENTOR	INVENTOR'S SIGNATURE	DATE
RESIDENCE		CITIZENSHIP
POST OFFICE ADDRESS		

ALL INVENTORS MUST REVIEW APPLICATION AND DECLARATION BEFORE SIGNING. ALL ALTERATIONS MUST BE INITIALED AND DATED BY ALL INVENTORS PRIOR TO EXECUTION. NO ALTERATIONS CAN BE MADE AFTER THE DECLARATION IS SIGNED. ALL PAGES OF DECLARATION MUST BE SIGN BY ALL INVENTORS.

Page 1 of 2 Pages [ ] Original [ ] Substitute [ ] Supplemental Atty. Docket:

Combined Declaration for Patent Application and Power of Attorney

As a below-named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name; and that I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled

Electroluminescent device and its method of manufacture

the specification of which (check one)

[ ] is attached hereto;
[ ] was filed in the United States under 35 U.S.C. §111 on _____, as U.S. Appln. No. _____*; or
[X] was/will be filed in the U.S. under 35 U.S.C. §371 by entry into the U.S. national stage of an international (PCT) application, PCT/BE00/00090 ; filed July 28, 2000_____, entry requested on _____*; national stage application received U.S. Appln. No. _____*; §371/§102(e) date _____* (* if known)

and was amended on _____ (if applicable).
(include dates of amendments under PCT Art. 19 and 34 if PCT)

I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above; and I acknowledge the duty to disclose to the Patent and Trademark Office (PTO) all information known by me to be material to patentability as defined in 37 C.F.R. §1.56.

I hereby claim foreign priority benefits under 35 U.S.C. §§ 119 (a)-(d) and 365 (b) of any prior foreign application(s) for patent, inventor's or plant breeder's rights certificate(s), or under §365(a) of any PCT application which designated at least one country other than the U.S., listed below:

Application No.	Country	Filing Date (MM/DD/YYYY)
09900516	Belgium	July 28, 1999

If I claimed foreign priority above, I hereby identify below any foreign application for patent (including an international (PCT) application designating a country other than the United States) or for an inventor's or plant breeder's certificate, having a filing date before that of the earliest application from which foreign priority is claimed (if left blank, then there are none):

Non-Priority Application No.	Country	Filing Date (MM/DD/YYYY)

I hereby claim the benefit under 35 U.S.C. §119(e) of any United States provisional applications listed below:

Application No.	Filing Date (MM/DD/YYYY)

I hereby claim the benefit under 35 U.S.C. §120 of any prior U.S. non-provisional application(s) or under §365(c) of any prior PCT international application(s) designating the U.S., listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in such U.S. or PCT international application in the manner provided by the first paragraph of 35 U.S.C. §112, I acknowledge the duty to disclose to the PTO all information which is material to patentability as defined in 37 C.F.R. §1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application:

Application No.	Filing Date (MM/DD/YYYY)	Status (patented, pending, abandoned)

As a named inventor, I hereby appoint the following registered practitioners to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith:

All of the practitioners associated with Customer Number 001444

Direct all correspondence to the address associated with **Customer Number 001444**, which is presently:

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